1980 RIDERSHIP POTENTIAL ON ALTERNATIVE RAPID TRANSIT FACILITIES IN METROPOLITAN TORONTO

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Prepared for

The Metropolitan Toronto Planning Board

By

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INTRODUCTION

Following the establishment of a series of modal split relationships[1], a study was undertaken to apply these relationships to determine the potential 1980 ridership on a number of rapid transit alternatives in Metropolitan Toronto.

It is the purpose of this report to summarize the results of this study, including the methodology adopted, the data and assumptions employed and the resulting estimates of potential ridership on each of the rapid transit alternatives. An attempt has also been made to qualify these ridership estimates with respect to the assumptions made and the relative sensitivity of the technique.

The rapid transit alternatives which were tested in the study are displayed in Figure 1 and are listed below:

The extension of the Yonge Street Subway from Sheppard Avenue to Steeles Avenue

Two alternative alignments in the Spadina corridor, terminating at Wilson Avenue

The Queen Street alignment from South Kingsway to Victoria Park Avenue

Two alternative alignments in the Weston-Queen Street corridor.

Throughout the course of the study, close liaison was maintained between Kates, Peat, Marwick & Co. (KPM) and the Metropolitan Toronto Planning Board (MTPB).

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1. "Modal Split Analysis for the 2 Hour 7-9 A.M. Peak Period in Metropolitan Toronto" - Prepared for the Metropolitan Toronto Planning Board by Kates, Peat, Marwick & Co., July 1967.

SUMMARY OF RESULTS

In addition to the rapid transit alternatives listed previously, estimates of ridership were prepared for the existing and presently committed rapid transit network (base system), that is,

> Bloor Street subway from Islington Avenue to Warden Avenue
>
> University Avenue subway
>
> Yonge Street subway from Sheppard Avenue to Union Station.

Certain of the alternative rapid transit facilities tested in this Study will divert a portion of their estimated total ridership from the base system. Where this occurred, in order to measure the significance of this diversion, revised estimates of ridership were prepared for the base system.

BASE SYSTEM RIDERSHIP

The ridership estimates for the base system are shown in Figure 2. These volumes are representative of the inbound travel direction for the 7-9 a.m. peak period.

The potential parking space requirements for trips external to the Metropolitan Toronto boundaries are:

> 700 spaces at Sheppard Avenue
>
> 300 spaces at Islington Avenue

The estimated total transit trips generated by all zones

within Metropolitan Toronto and destined to downtown Toronto (zones 1 to 5) are shown in Figure 3.

RIDERSHIP ON THE SPADINA ALTERNATIVES

The ridership estimates for the Spadina-St. George and Spadina-Bathurst alignments are shown in Figures 4 and 5. In the case of the Spadina-St. George alignment, a revised estimate of the ridership on the base system was also computed and is displayed in Figure 4.

A comparison of Figure 2 and Figure 4 indicates that the majority of the ridership estimated for the Spadina-St. George alignment is diverted from the base system. This facility has very little impact on transit patronage within the Spadina corridor; it serves mainly to divert ridership from adjacent surface transit lines which would alternatively feed either the Bloor or the Yonge subways.

A further statement of the impact of this facility on transit ridership in the Spadina corridor is provided in Table 1. This table summarizes the modal split for trips from the zones within the corridor to downtown (zones 1 to 5) for the base system and for the base system plus the Spadina-St. George facility. For some zones, a net decrease in modal split, from the base system to the Spadina test, was estimated. While this may appear unreasonable, the zones in question are located close to the Spadina facility and are assumed to be within walking

distance of the nearest station. In the base system test, the same zones were served by a feeder bus system which terminated at the Bloor or Yonge subway. While the total travel time for a journey to downtown from these zones decreased with the introduction of the Spadina facility, the non-travelling time (walking to the station versus walking to the feeder bus) increased; the effect of this increase in non-travelling time more than offsets the effect of the decrease in total travel time. Other zones experience marginal increases in modal split due to the introduction of the Spadina facility, for reasons previously described.

This high sensitivity to non-travelling (excess) time in the transit journey clearly indicates the importance of this component of the total trip time. Furthermore, to maximize the impact of any rapid transit facility requires the minimizing of transit excess time through the complementary provision of a good feeder bus system.

It should be noted at this time that certain initial assumptions regarding the Spadina-St. George facility had to be changed in order that this facility would attract reasonable ridership. Originally stations were located at Wilson Avenue, Ranee Avenue, Lawrence Avenue, Glencairn Avenue and Eglinton Avenue. Furthermore, the operating speed north of Eglinton Avenue was assumed to be 18 miles per hour. With these assumptions for the Spadina-St. George facility, most ridership in the Spadina corridor was attracted to the Yonge Street subway because

TABLE 1

COMPARISON OF THE ESTIMATED MODAL SPLIT VALUES IN 1980 FROM ALL ORIGINS IN THE SPADINA CATCHMENT AREA TO THE DOWNTOWN AREA (SUPERZONES 1, 2, 3, 4, 5) WITH AND WITHOUT THE SPADINA RAPID TRANSIT SYSTEM

Origin Zone No.	Spadina-St. George Alternative Modal Split	Base System Modal Split
18	.46	.46
19	.36	.37
21	.50	.47
22	.47	.43
23	.58	.62
24	.63	.59
25	.56	.51
26	.58	.49
27	.45	.55
28	.74	.73
29	.74	.72
30	.73	.72
38	.71	.65
39	.60	.64
40	.87	.76
41	.55	.55
42	.62	.55
43	.61	.58
91	.55	.59

of its faster operating speed and wider station spacing.

Thus, to make the Spadina facility competitive with the Yonge facility, the stations at Ranee Avenue and Glencairn Avenue were removed, and the operating speed north of Eglinton Avenue was increased to 30 miles per hour.

The main feature of the Spadina-Bathurst alignment is the significant diversion of patronage from the University Avenue line. North of Bloor Street, the estimated ridership on this alternative is practically the same as was estimated for the Spadina-St. George alignment. While providing good service for a small area west of University Avenue and south of Bloor Street, the Spadina-Bathurst alignment would provide only a marginal return on the additional capital required to construct the Bathurst Street section.

QUEEN STREET RIDERSHIP

The ridership estimates for the Queen Street facility are shown in Figure 6. Comparison with Figure 11 indicates the Queen Street line diverts a maximum of 6,000 trips from the Bloor subway east of Yonge Street. In contrast there is very little diversion from the Bloor subway west of Yonge Street.

Because this service is introduced into an area experiencing high modal split rates (as high as 88 percent) for trips oriented to the downtown, its impact in increasing transit ridership is minimal. Thus, this facility attracts the majority

of its estimated patronage through diversion from parallel surface transit and the Bloor subway.

RIDERSHIP ON THE WESTON-QUEEN ALTERNATIVES

The ridership estimates for the Weston-Queen alternatives are presented in Figure 7. There is practically no difference, in terms of potential ridership, between the alternative alignments at the Weston end of this facility. The eastern leg of this facility, which runs north on Greenwood Avenue, tends to divert patronage from the Yonge Street line north and south of Bloor Street and from Bloor Street line via the transfer at their point of crossing.

RIDERSHIP ON THE YONGE SUBWAY EXTENSION

Because of the effective feeder bus system to the Sheppard Avenue station of the Yonge subway in the base system, the extension of this subway to Steeles Avenue will not appreciably increase the transit ridership in the Yonge corridor. Thus, the ridership estimates on the two sections north of Sheppard Avenue result from a diversion of trips from the Sheppard Avenue station and a re-allocation of these trips to the Finch Avenue and Steeles Avenue stations.

The estimated ridership on the Yonge extension from Sheppard Avenue to Finch Avenue is 4,400 trips (inbound)

and from Finch Avenue to Steeles Avenue is 1,000 trips, as displayed in Figure 2.

No parking facilities were assumed at the Steeles Avenue station. If parking were provided, however, the above estimates from Sheppard to Finch would increase to 5,400 trips and from Finch to Steeles would increase to 2,000 trips.

SENSITIVITY OF THE BASE SYSTEM RIDERSHIP ESTIMATES TO PARKING COSTS

The ability of any planning technique to estimate the present is of no particular value unless it can also reliably predict the future. Future year estimates are contingent upon the independently estimated input variables (cost, time, income, etc.), as well as the ability of the technique to relate these independently estimated inputs to modal choice. Thus, it is wise to test the sensitivity of the dependent variable (modal split) to changes in the independent variables (cost, time, income, etc.) in order to gain some insight into the possible forecast range. For this purpose, one test of this nature was undertaken. This test involved doubling the vehicle parking cost in downtown Toronto.

The results of doubled parking charges on the base system ridership estimates can be determined by comparing Figure 8 and Figure 2. The cost ratios (transit to auto trip cost), for the analysis employing doubled parking costs, in some

cases were in a range of the modal split curves not originally established by substantial factual data. Notwithstanding this fact, the results of this analysis appear reasonable, and do provide insight into the sensitivity of modal choice to one of the input variables (parking cost).

METHODOLOGY

BASIC SYSTEMS TESTS

The sequence of operations employed in this study is graphically displayed in Figure 9. This methodology follows a systematic procedure that provides a link by link summary of the estimated transit ridership on each alternative rapid transit facility. Reference may also be made to a previous report[2] for a detailed description of this technique.

The technique first requires the definition of a zoning system and the assembly of total person trip data compatible with that zoning system. A catchment area (travel corridor) then has to be defined for each facility to be tested. Such factors as the population and employment densities, the configuration of the local and feeder bus systems, the income of the origin zones, and the presence of travel barriers are all used to define the limits of the travel corridor.

Within each travel corridor, a maximum of 500 origin-destination (O-D) pairs of zones are used in the computation of ridership on the rapid transit facilities. This maximum number of O-D pairs of zones was established to ensure that

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2. "Manual Technique for Estimating Transit Demand in a Selected Travel Corridor" - Prepared for the Metropolitan Toronto Planning Board by Traffic Research Corporation (now Kates, Peat, Marwick & Co.), November 1966.

the manual computational effort involved is maintained at a workable level. Incremental additions to these ridership estimates, resulting from trips between origin-destination pairs of zones not considered in this analysis, are negligible.

For each O-D pair of zones used in this analysis, several computations have to be undertaken, as listed below:

Transit and vehicle door-to-door travel time (including walking, waiting and transferring time in the transit mode)

Transit fare

Vehicle operating and parking cost

The ratio of the transit to vehicle travel times and costs

Transit non-travelling (excess) time, that is, the time spent walking, waiting and transferring.

Two transit routes, for each O-D pair of zones, are manually selected; the minimum time route and the most likely alternative route (Figure 10). The total non-travelling and total transit O-D times are determined by extracting these respective times from the minimum time transit route.

Once the number of transit trips are computed for each O-D pair, they are proportioned between the two routes according to an assignment factor (Figure 20), which is dependent upon the ratio of the total travel times by each route.

When the number of transit trips on each O-D route is known, the on-off points on the facility to be tested are recorded, and a link by link summary of the ridership forecasts is prepared.

Sample Calculation

Vehicle door-to-door travel time		=	27 minutes
Transit door-to-door travel time		=	62 minutes
Vehicle operating and parking cost		=	68 cents
Transit fare		=	25 cents
Transit excess time		=	13 minutes

Income classification = EC2 (i.e. $3500 to $4749)

Travel time ratio $= \frac{62}{27} = 2.30$

Travel cost ratio $= \frac{25}{68} = 0.37$ (CR2)

Thus, employing the modal split relationships previously developed, and shown graphically in Figure 19, the modal split rate for the conditions described above is 45 percent. That is, 45 percent of the total trips will travel by transit.

ALTERNATIVE ALIGNMENTS IN THE SAME TRAVEL CORRIDOR

In the Spadina and Weston travel corridors, slight variations in the main alignments were tested. In the Spadina travel corridor the Spadina-Bathurst system was considered alternatively to the Spadina-St. George System. In the Weston travel corridor the Richview alignment was considered alternatively to the Weston alignment.

Because of the reasonably coarse zoning system employed, the differences between slight alignment variations within the same travel corridor cannot be accurately measured. Hence,

a less rigorous method was developed to estimate ridership on these alternative alignments. This method was applied to the alternative alignments for the Spadina and Weston-Queen rapid transit facilities, and essentially involved a modal split computation for selected O-D pairs of zones and a reasignment to the alternative alignment. The O-D pairs of zones were selected to measure the difference in modal split of the alternative over the original alignment. Adjustments were then applied to the remaining O-D pairs of zones to reflect this difference and the revised transit trips were assigned to the alternative alignment.

YONGE STREET SUBWAY EXTENSION

The extension of the Yonge subway from Sheppard Avenue to Steeles Avenue was evaluated in the same manner as the evaluation of alternative alignments in the same travel corridor. That is, a modal split computation was undertaken for a selected few O-D pairs of zones, with the new facility from Sheppard to Finch as part of the transit system. Then adjustments were made to the modal split for all O-D pairs of zones affected by this new facility, followed by an assignment to the new facility.

The rather large superzones adjacent to this test facility were subdivided to provide a reasonable assignment of patronage to the three available stations (at Sheppard, Finch and Steeles Avenues).

PARK AND RIDE ESTIMATES

Parking facilities were assumed to be provided near the Sheppard Avenue station on the Yonge Street line and near the Islington Avenue Station on the Bloor Street line.

The method employed to determined the potential utilization of these parking lots involved a judgemental division of the subway patrons, by mode of arrival at the terminal end of the subway, between bus 'n ride and park 'n ride. For each of the two combinations of bus-subway and auto-subway trip, a modal split was computed for the total O-D journey. Then, based on the division by mode of arrival at the station, a weighted overall modal split was computed and the resulting estimate of transit trips was divided into the two access modes (bus and auto). That portion designated as park 'n ride was divided by an auto occupancy factor of 1.3 to determine the number of parking automobiles. The summation of the parking automobiles, for all O-D pairs of zones considered, resulted in an estimate of the utilization of each of the two parking lots.

This method was applied only to those trips originating outside the limits of Metropolitan Toronto and destined downtown (reference Figure 17 displaying origin zones outside Metropolitan Toronto). The modal split relationships were derived from base data (1964 Home Interview Survey) which did not contain a significant amount of mixed mode travel. For this reason,

it was considered unwise to use this method within Metropolitan Toronto where large numbers of downtown oriented trips, well served by public transit are involved. This method of estimating mixed mode travel is unable to measure the more subtle differences in characteristics which distinguish between the park 'n ride and bus 'n ride traveller. The method, however, was considered satisfactory for application to trips originating outside Metropolitan Toronto because of the small numbers of trips involved.

ASSUMPTIONS FOR TESTS

For each travel corridor studied, certain basic assumptions had to be made and detailed system characteristics of the facilities to be tested had to be defined. The final ridership forecasts are therefore those resulting from the assumptions made, and can only be considered valid so long as the assumptions affecting the forecasts remain valid. The assumptions and their sources are listed below.

Public Transit Facilities

For each rapid transit facility tested, an associated feeder bus system was specified. The feeder buses were assumed to be semi-express in operation (i.e. stopping only at major intersections) and would shuttle to and from the subway; thus, transit access to the rapid transit stations could be achieved by feeder bus, local bus or local bus transferring to feeder bus.

Station location and operational speed had to be specified, as described in the following paragraphs.

Figure 11 displays the assumptions associated with the base system. The operating speed on the base system was assumed to be 18 miles per hour, except between Sheppard Avenue and Eglinton Avenue on the Yonge Street line, where a speed of 30 miles per hour was assumed. This higher operating speed was assigned primarily on the basis of increased station spacing north of Eglinton Avenue.

For this test, the Y operation between the N-S and E-W lines was assumed. This assumption provided slightly higher estimates of the loading on the Bloor Line, compared to the assumption of independent operation of N-S and E-W services. The order of magnitude of the difference was estimated to be less than five percent at the maximum load points.

Two alternative alignments were tested in the Spadina travel corridor, as displayed in Figure 12. In both cases the operating speed on the Spadina line below Eglinton Avenue was assumed to be 18 miles per hour. Between Eglinton Avenue and Wilson Avenue a 30 mile per hour operating speed was used.

In the first Spadina Test, the Spadina line was assumed to be an extension of the University Avenue line, and thus integrated with the present University-Yonge subway operation. The Bloor line was assumed to operate independently of the Spadina-University-Yonge service.

The second Spadina test followed an alignment along Bathurst Street and King Street, dead ending at the St. Andrews station on the University Avenue line.

Figure 13 presents the details of the Queen Street test. In this test, a rapid transit facility operating at 18 miles per hour was assumed along Queen Street, from South Kingsway to Victoria Park Avenue.

Two alternative alignments were tested in the Weston travel corridor, as shown in Figure 14. In the first case rapid transit service was assumed along the existing rail alignment from Islington Avenue north of Dixon Road, through Weston to downtown. In the second case an alternative terminal alignment was tested which ran from Richview Side Road and Highway 27 to Eglinton Avenue and Weston Road.

The Weston Line was assumed to follow Queen Street from Dufferin Street to the downtown. On the east side of the Downtown, the rapid transit facility followed Queen Street to Greenwood Avenue and north on Greenwood Avenue to O'Connor Drive.

The speed on the Weston-Queen line was assumed to be 18 miles per hour, except west of the intersection of Jane Street and Weston Road where a 30 mile per hour speed was used.

An estimate was also prepared for the expected volumes on a Yonge line extension from Sheppard Avenue to Steeles Avenue (Figure 15). The line was assumed to have an operating speed of 30 miles per hour for this section.

The characteristics of the changes to all other surface transit facilities, between 1964 and 1980, were taken from the MTARTS 1980 Demand Study. These characteristics are listed in the appendix to this report.

Vehicle Facilities

The characteristics of the changes to the vehicle system, between 1964 and 1980, were taken from the MTARTS 1980 Demand Study. These characteristics are listed in detail in the appendix to this report.

Zoning System

The zoning system for this test was developed from the zoning system used in the MTARTS 1980 Demand Study. Because of the computational effort involved for each O-D pair of zones in a travel corridor, this latter zoning system had to be aggregated to a more coarse zoning system, to reduce the number of O-D interchanges to a maximum workable level of 500. Thus, a system of 80 superzones within Metropolitan Toronto (Figure 16) was developed from an aggregation of the 244 zones used in the 1980 Demand Study. Five zones were considered outside Metropolitan Toronto as shown in Figure 17. When zones were grouped together to form a superzone, an attempt was made to group only those zones which had approximately equal incomes and accessibility to major transit facilities. It was then assumed that all trips in a superzone would originate from the zone which most nearly represented the centre of trip making activity within the superzone.

The effect of using a coarse zoning system has resulted in some uneveness in the loading on the facilities tested. During the analysis phase, however, it was found that this uneveness had very little effect on the absolute ridership forecasts at the maximum load points.

Total Trip Data

The total person travel patterns estimated for the 7-9 a.m. peak period in the MTARTS 1980 Demand Study provided the source of total travel demand for this study.

Cost Data

Vehicle half-daily parking charges were assessed in the downtown area as shown in Figure 18. Only one-half the daily parking charge, applied to the round trip, is assessed to the one-way a.m. peak leg of the trip. These parking charges were developed from economic parking costs established in 1964, relating land values and employment density to the economic cost of supplying parking space. The 1980 parking charges were obtained by factoring the 1964 economic parking costs by the ratio of average 1980 worker income to average 1964 worker income.

To the half-daily parking charges were added the vehicle operating costs, derived from the Traffic Prediction Model for the 1980 Demand Study, for O-D pairs of zones within each travel corridor.

Single transit fares of 25 cents (expressed in 1964 dollars) were employed in this study, and it was assumed that only one fare zone would exist in Metropolitan Toronto in 1980.

Parking charges at the two subway terminal parking lots, at Sheppard Avenue and Yonge Street and at Bloor Street and Islington Avenue, were assessed on the daily basis of 75 cents (two tokens plus parking = $1.25).

Modal Split Curves

The modal split relationships employed in this analysis were developed in the first phase of this study (reference Introduction) and are graphically displayed in Figure 19.

Assignment Factor Function

Figure 20 graphically displays the assignment factor, or submodal split function which was used in this study to proportion the total transit trips between the two alternative transit routes, for each O-D pair of zones.

ANALYSES

During the course of the manual calculations, quality control checks were continuously undertaken to minimize human errors and to ensure consistency and reliability of the results. Further analyses of the technique and the results were undertaken as described below.

COMPARISON OF MANUAL AND COMPUTER RESULTS

To reduce the computational effort associated with this technique to a workable level, certain revisions have to be made to the normal computer oriented set of operations. The major revision required, as previously discussed, is the development of a zoning system which is more coarse than is normally used in the computer studies. The establishment of such a zoning system in this case involved the aggregation of an average of three 1980 MTARTS zones into one superzone. The travel characteristics of the zones with the superzone were averaged and were associated with the 1980 MTARTS zone which was judged to be representative of the group.

The computer modal split technique interpolates between the ranges of travel time ratio, level-of-service ratio and cost ratio. To reduce the manual computations, the cost ratio interpolation was eliminated.

Following the first set of ridership estimates (on the

base system) a computer check was made on these estimates using the modal split relationships displayed in Figure 11 and the MTARTS 1980 demand vehicle and transit network. The transportation systems in both cases were compatible, with the exception of the Spadina rapid transit facility in the MTARTS network. The results of this check indicated that no serious biases existed in the manual technique resulting from the above mentioned simplifying assumptions. Small biases that were pointed out from this comparison were corrected before proceeding with the remaining systems tests.

COMPARISON WITH MTARTS 1980 DEMAND STUDY

Comparison of the ridership estimates on the base system plus the Spadina-St. George alignment with the MTARTS 1980 Demand ridership on the compatible rapid transit system indicated one area of significant difference. The ridership estimates on the Spadina facility reached a maximum of approximately 6,000 trips in the 1980 Demand Study as compared with approximately 18,000 trips in this study.

The difference between the two studies may be attributed to differences in input assumptions, rather than the technique. Essentially this study assumed a higher speed on the Spadina facility, a more extensive feeder bus system, relatively higher parking costs in the downtown and lower transit fares in the outlying areas (25 cents versus two fare zones of

17 cents equalling 34 cents in the MTARTS study). These factors all contribute to a higher modal split than was achieved in the 1980 MTARTS Demand Study and are felt to be the main reasons for the discrepancies between the two studies.

The result of this comparison serves to point out how the ridership estimates depend on the transportation networks and other input assumptions employed.

IMPLICATIONS OF POSSIBLE BIASES IN 1980 DEMAND TRIP TABLE

The basic trip data used in this study was developed in the MTARTS 1980 Demand Study. This data was in the form of a table of total person trips and was developed from a gravity model trip distribution, using parameters calibrated from the 1964 Home Interview Survey. Although the gravity model was considered to adequately reproduce the observed 1964 travel patterns in the whole of the MTARTS Region, certain corridors of travel in Metropolitan Toronto appeared to contain slight trip distribution biases. In most cases these biases involved a slight undersimulation of total person trips.

These biases were examined with respect to the 1980 trip distribution for downtown oriented trips, in order to assess their possible implications on the estimated ridership for the base system. It must be noted at this point that most of the biases that existed in the 1964 trip distribution were within the standard range of estimating error for this

type of simulation. Furthermore, there is no reason to believe that the underlying causes of these biases will still exist in 1980. Notwithstanding this fact, the examination of the implications of these possible biases provide some insight into the possible range of the 1980 ridership estimates.

Corrections for these trip distribution biases would result in a maximum increase in ridership of 5,000 transit trips in the Yonge-Spadina corridor (including both the Yonge and Spadina lines) north of Bloor Street. Similarly the loading on the Bloor Street line east of Yonge Street would be increased by a maximum of 3,000 trips and the loading on the Queen Street line east of Yonge Street would be decreased by a maximum of 3,000 trips. The loading on the University Avenue line and the Bloor and Queen lines west of Yonge Street would be virtually unaffected by trip distribution biases.

The interpretation of this information, because of the uncertainty of the existence of these biases, should be general rather than specific. That is, the ridership estimates on the Yonge, Spadina and Bloor Street east lines could be conservative while the ridership estimates on the Queen east line could be slightly liberal.

SENSITIVITY OF THE RIDERSHIP ESTIMATES

As previously stated, the ridership estimates prepared in this study are valid for a fixed set of input assumptions.

Furthermore, these estimates may be quite sensitive to changes in some of the input assumptions. Thus, in order to evaluate the implications of possible variations to the systems tested in this study, the sensitivity of the estimated modal split has been examined with respect to the three independent variables which would be affected by variations in the systems. This examination is based on the following set of "average" trip conditions within Metropolitan Toronto:

Travel time by transit = 36 minutes
Travel time by vehicle = 24 minutes
Transit excess (non-travelling) time = 12 minutes
Transit cost = 25 cents
Vehicle cost = 62 cents
Average worker income = $5,200

therefore,

$$\text{The travel time ratio} = \frac{36}{24} = 1.5$$

$$\text{The cost ratio} = \frac{25}{62} = 0.4$$

The excess time = 12 minutes

Under these conditions the modal split estimate is 57 percent.

If the travel time ratio and cost ratio are not altered and the transit excess time is increased by two minutes (i.e., one transfer) the estimated modal split decreases to 49 percent.

In order to effect the same increase in modal split, the transit travel time has to be increased from 36 minutes to 45 minutes, or the transit fare has to be increased from 25 cents to 34 cents.

Thus, a 15 percent change in transit excess time (from 12 to 14 minutes) has the same effect on modal split as a 25 percent change in transit travel time or a 35 percent change in transit cost, for the previously referenced "average" conditions.

This example serves to illustrate the relative sensitivity of the traveller's mode choice preferences in Metropolitan Toronto, to changes in the determinant systems variables. This mode choice is significantly sensitive to transit excess time and hence should be a prominent consideration in the planning of any integrated feeder bus-rapid transit system.

While this example illustrates the general effects of changes in the input parameters for a particular condition, the specific assessment of the implications of major variations to the systems tested in this study would require a more comprehensive and systematic approach.

CONCLUSIONS

The terms of reference for this phase of the priority studies required the production of 1980 ridership estimates for the rapid transit alternatives discussed in this report. The estimates produced in this report fulfill these terms of reference and are valid with respect to the input assumptions employed. By themselves, however, these estimates do not provide sufficient information to assign relative priorities, rather, they provide one component of a number of independent planning and operations criteria which must be considered in the process of assigning priorities. Such objective criteria as cost-benefit analyses, potential overloading of the base system, the level-of-service by vehicle and transit within the same travel corridor, all must be considered for each alternative rapid transit facility. Further subjective criteria and general planning considerations may also be prominent in the establishment of priorities.

It should be pointed out that the individual estimates of the ridership between particular stations may be distorted by the zoning system that was employed. For maximum computational efficiency, individual zones were grouped into superzones and these superzones were linked to a particular station. Therefore, instead of getting transit trips from a group of zones distributed over two or three stations, they were assigned to only one station. The result of this assignment procedure is the build up of trips in large groups at particular stations rather than a

more even distribution along all stations on the line. This assignment technique does not affect the absolute value of the number of transit trips at the maximum load point, however, it does distort the manner by which they are assigned to individual stations.

An analysis of the sensitivity of the ridership estimates to changes in the determinant variables, for a particular set of conditions, is presented in the previous section of this report. This analysis points out the underlying importance of non-travelling or excess time in the choice of public transit as a mode of travel. The minimization of this non-travelling portion of the total transit journey time is significantly important in the realization of maximum ridership potential on any rapid transit facility.

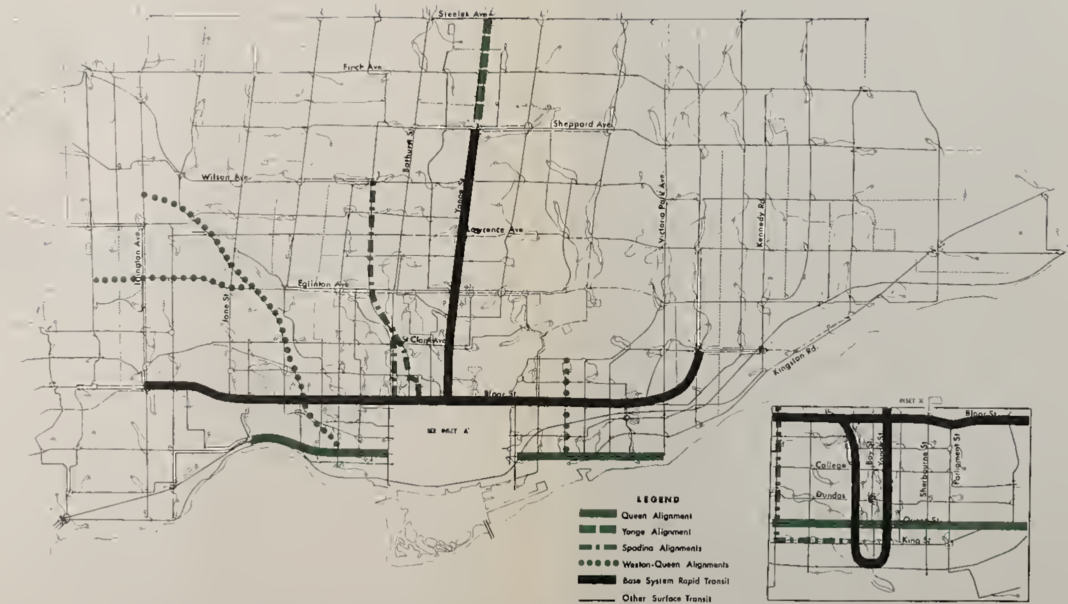
LIST OF FIGURES

LEGEND

Station Identification

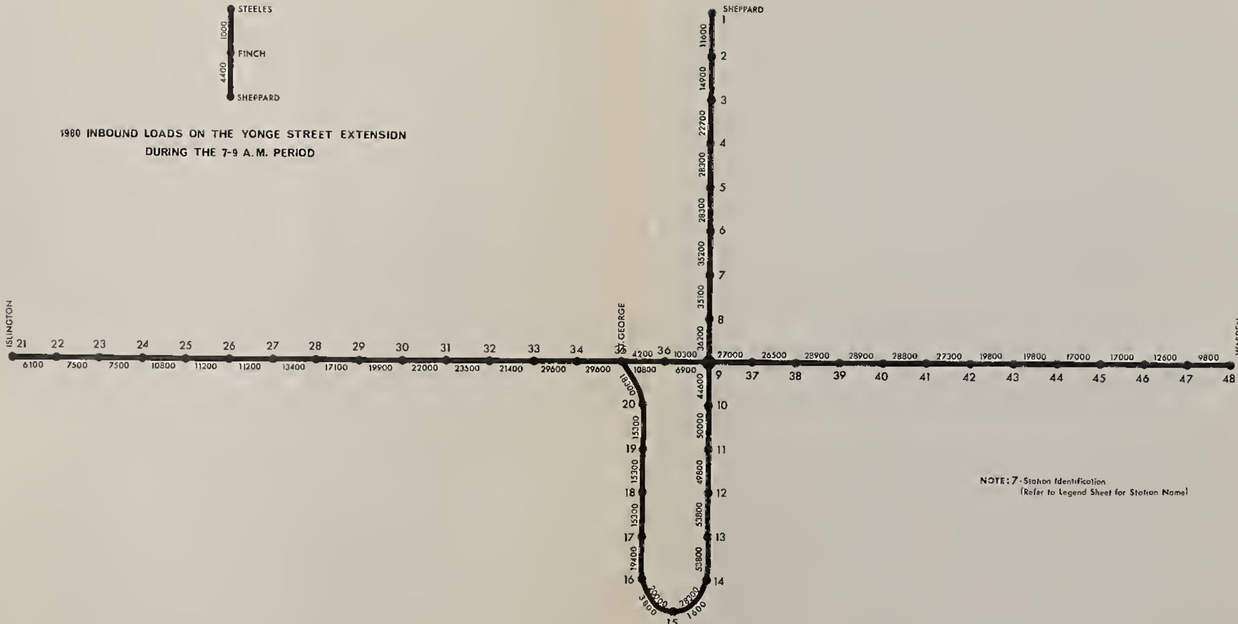
1	Sheppard	28	Dundas West
2	York Mills	29	Lansdowne
3	Lawrence	30	Dufferin
4	Eglinton	31	Ossington
5	Davisville	32	Christie
6	St. Claire	33	Bathurst
7	Summerhill	34	Spadina
8	Rosedale	35	St. George
9	Bloor-Yonge	36	Bay
10	Wellesley	37	Sherborne
11	College	38	Castle Frank
12	Dundas	39	Broadview
13	Queen	40	Chester
14	King	41	Pape
15	Union	42	Donlands
16	St. Andrew	43	Greenwood
17	Osgoode	44	Coxwell
18	St. Patrick	45	Woodbine
19	Queen's Park	46	Main
20	Museum	47	Victoria Park
21	Islington	48	Warden
22	Royal York	49	Wilson
23	Jane	50	Lawrence
24	Old Mill	51	Eglinton
25	Runnymede	52	Bathurst
26	High Park	53	St. Clair
27	Keele	54	Dupont

Fig. 1



PLAN OF RAPID TRANSIT FACILITIES TO BE TESTED

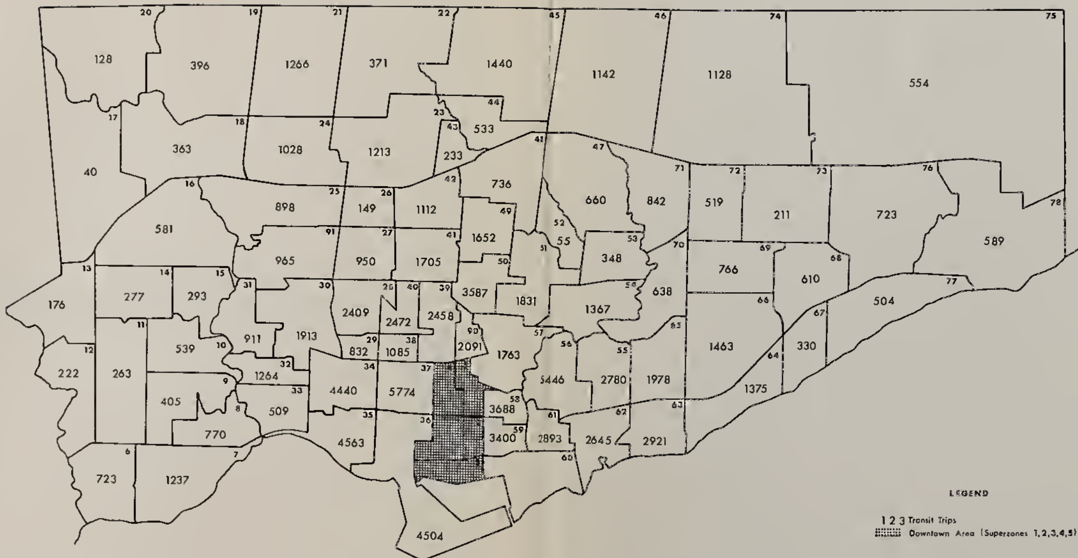
Fig. 2



1980 INBOUND LOADS ON THE YONGE STREET EXTENSION
DURING THE 7-9 A.M. PERIOD

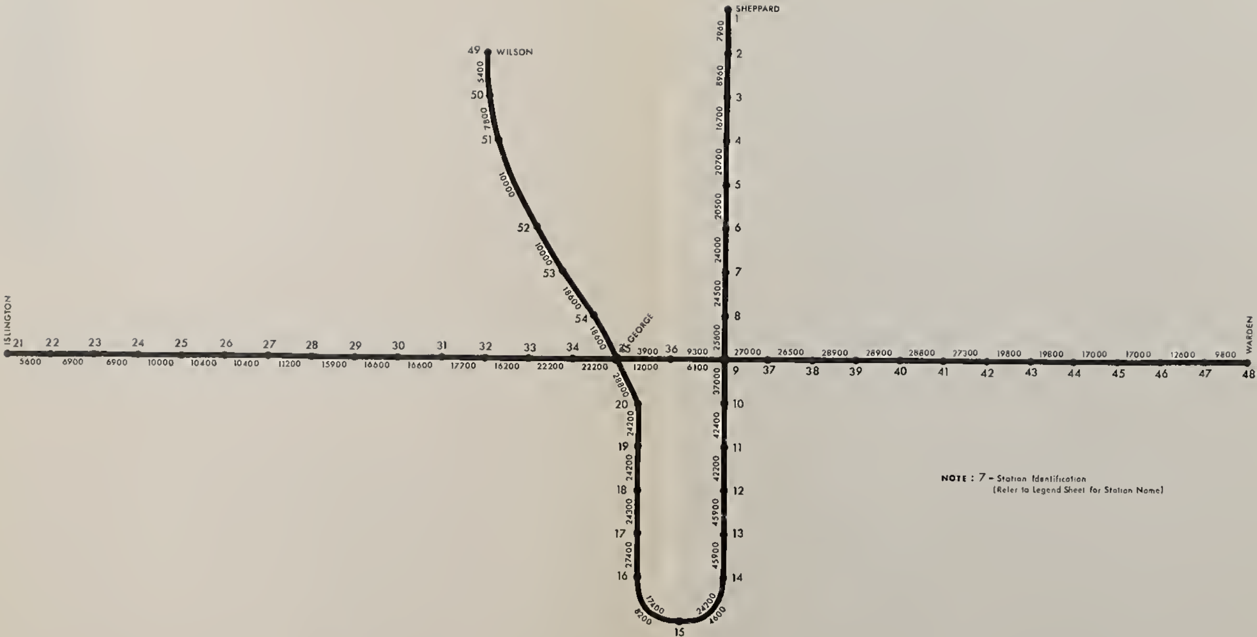
1980 INBOUND LOADS ON BASE SYSTEM DURING 7-9 A.M. PERIOD

Fig. 3



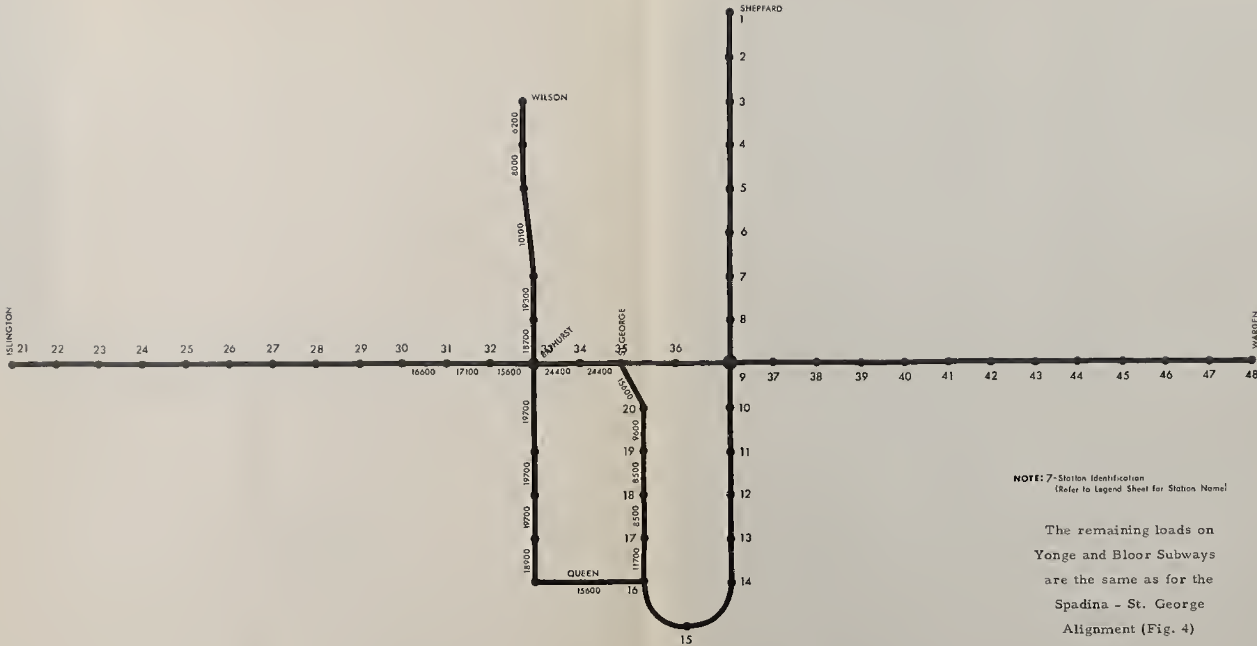
ESTIMATED 1980 TRANSIT TRIPS TO THE DOWNTOWN AREA FOR THE BASE SYSTEM

Fig. 4



1980 INBOUND LOADS ON SPADINA (ST. GEORGE ALIGNMENT)
AND BASE SYSTEMS DURING 7-9 A.M. PERIOD

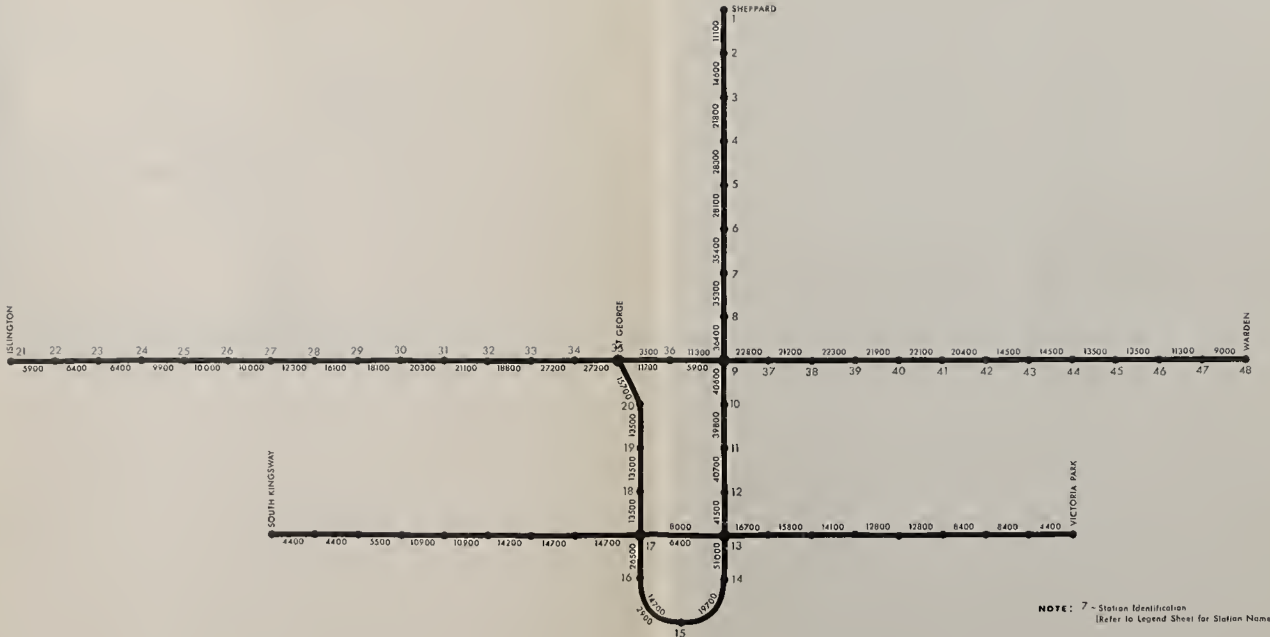
Fig. 5



NOTE: 7-Station Identification
(Refer to Legend Sheet for Station Name)

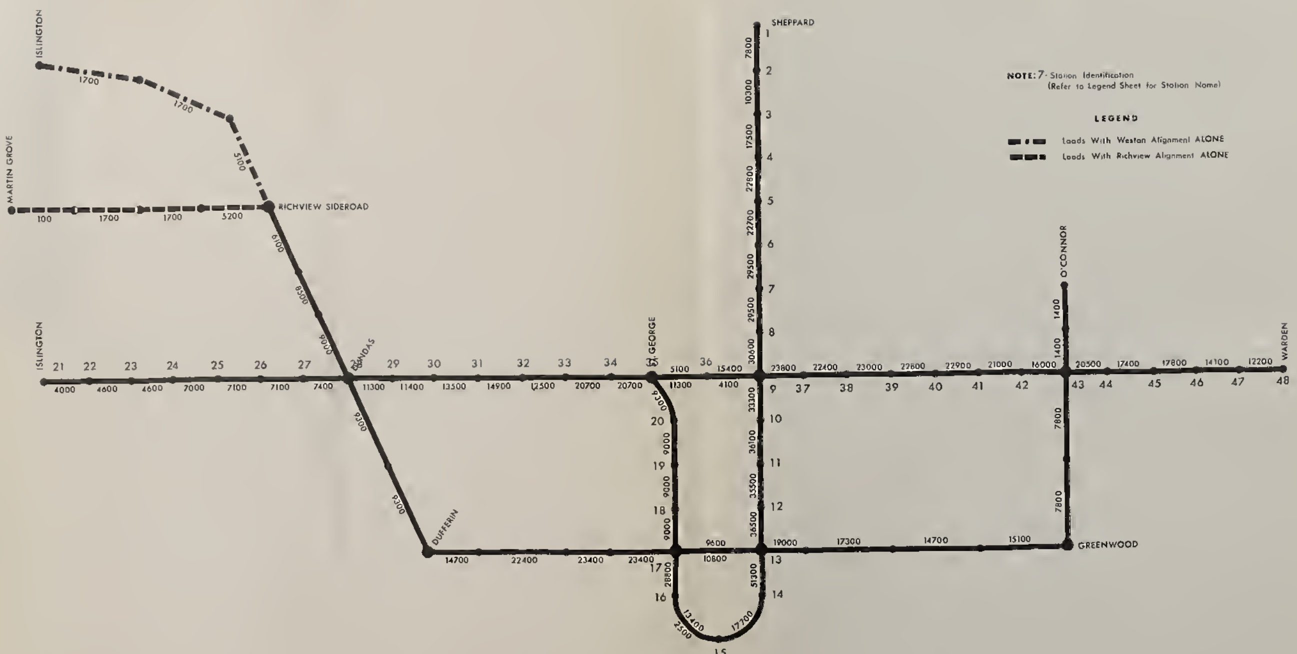
The remaining loads on Yonge and Bloor Subways are the same as for the Spadina - St. George Alignment (Fig. 4)

1980 INBOUND LOADS ON SPADINA (BATHURST ALIGNMENT)
SYSTEM DURING 7-9A.M. PERIOD

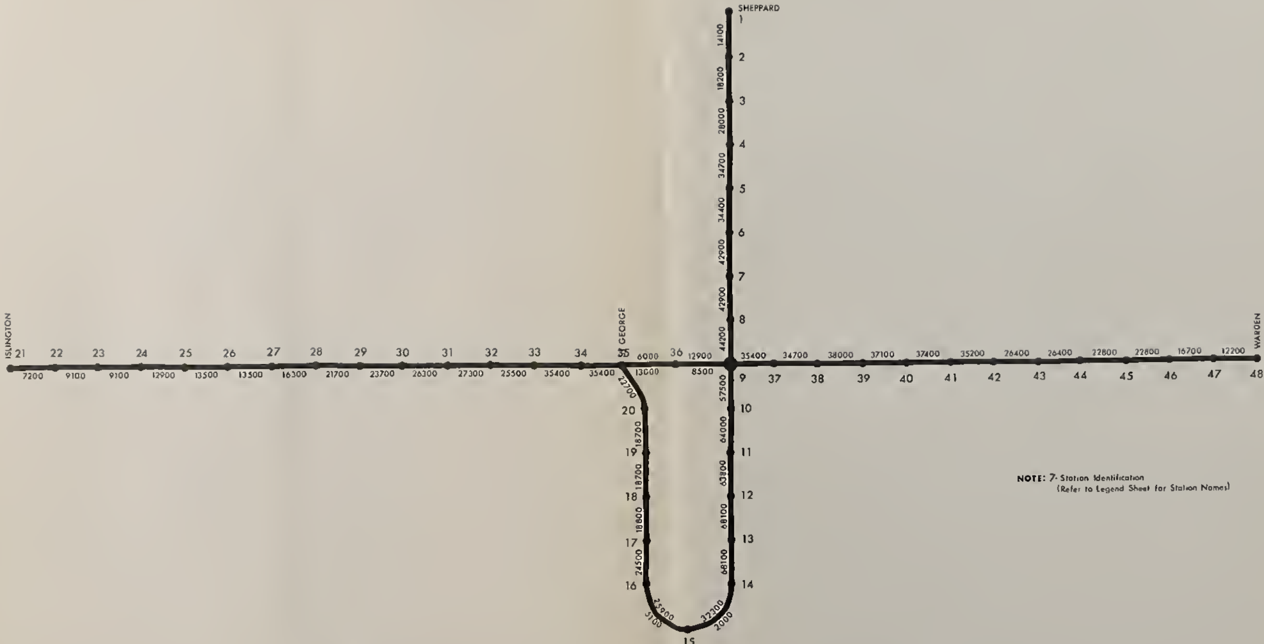


1980 INBOUND LOADS ON QUEEN ALIGNMENT DURING 7-9 A.M. PERIOD

Fig. 7



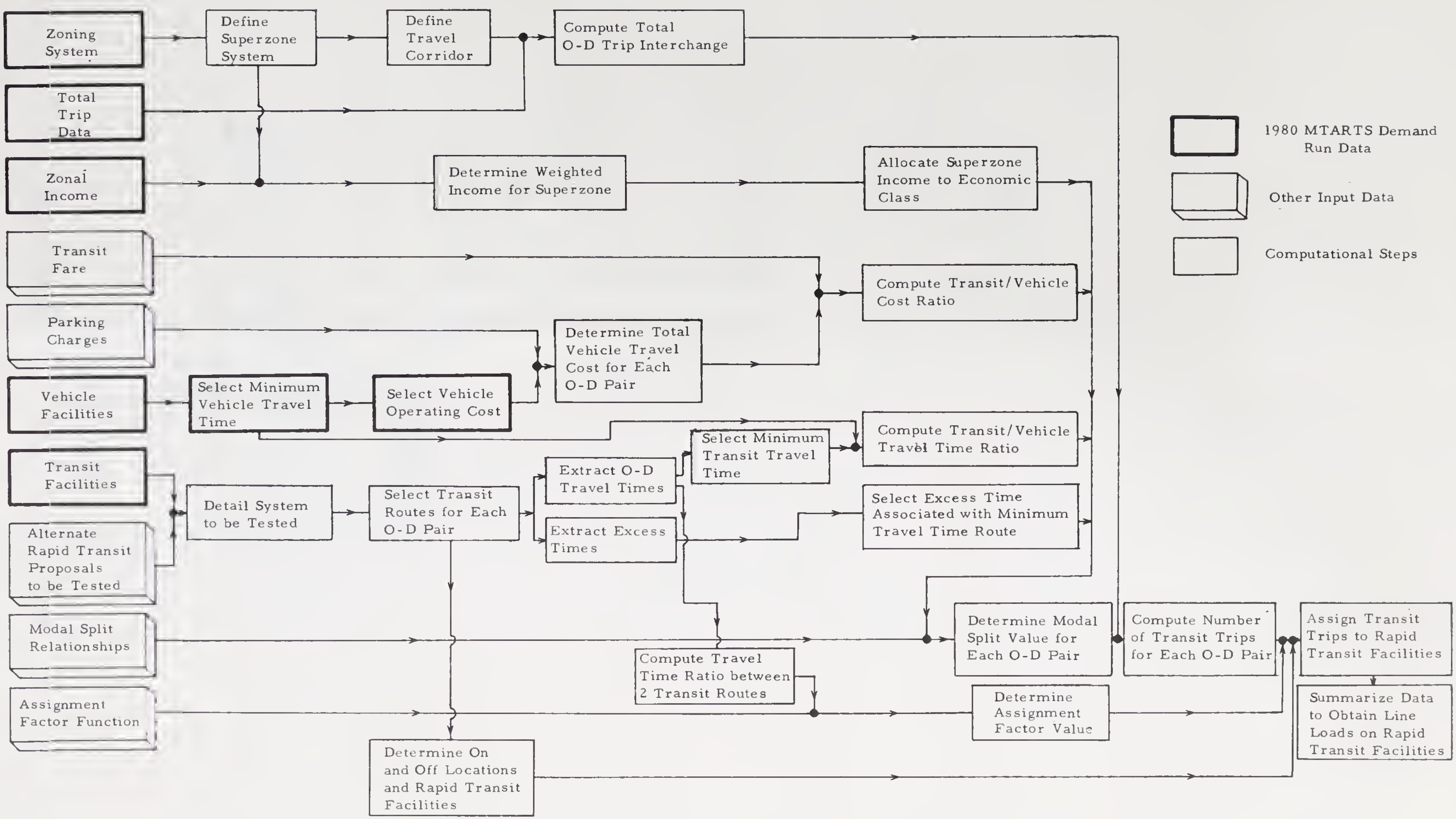
1980 INBOUND LOADS ON WESTON ALIGNMENT DURING 7-9 A.M. PERIOD

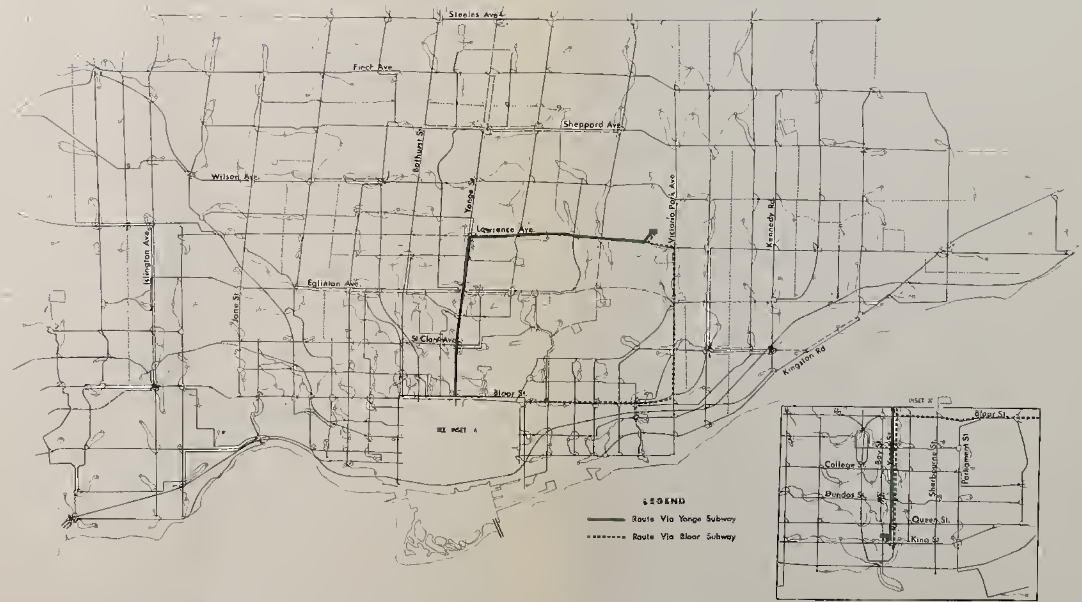


1980 INBOUND LOADS ON BASE SYSTEM DURING 7-9 A.M. PERIOD
WITH DOUBLED PARKING CHARGES

FLOW CHART OF METHODOLOGY

Fig. 9



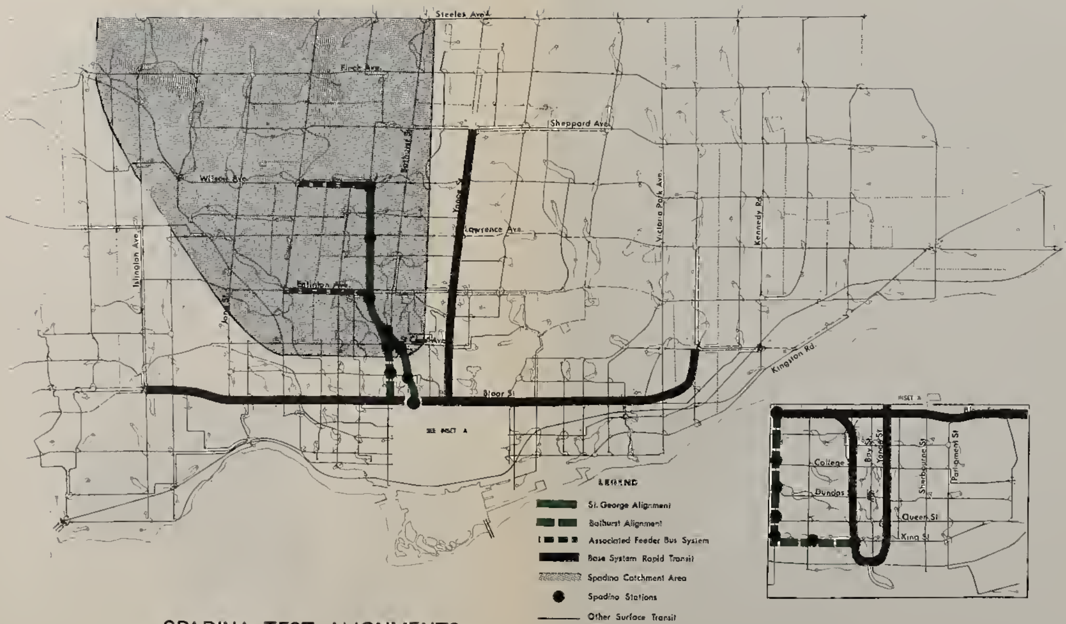


AN EXAMPLE OF ALTERNATE MANUALLY TRACED ROUTES

* NOTE:
The Base Subway System Consists of the Existing and Presently Committed Rapid Transit Facilities in Metropolitan Toronto

BASE SYSTEM* ALIGNMENT

Fig. 12

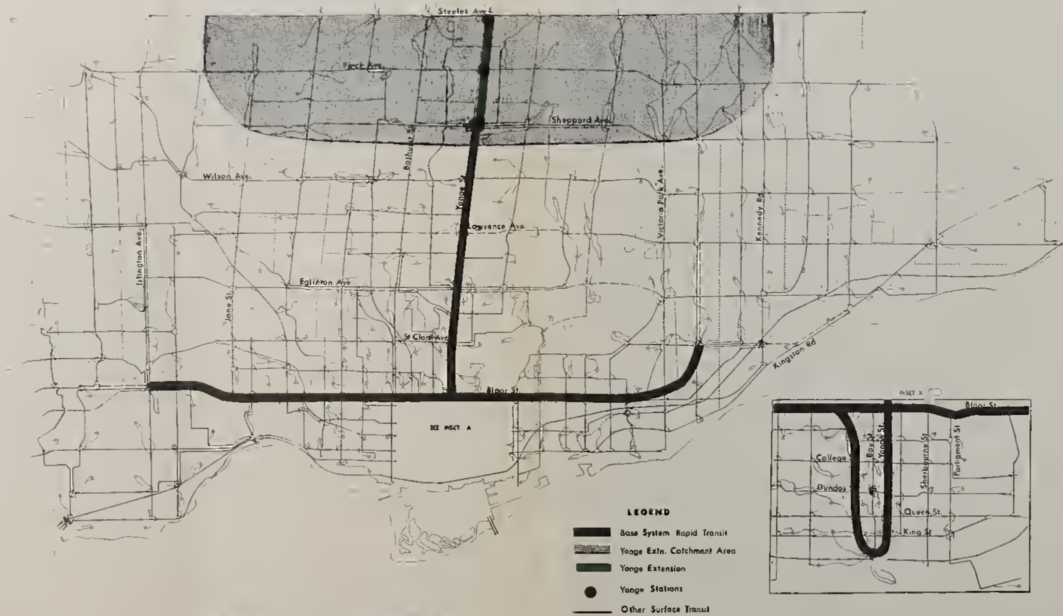


SPADINA TEST ALIGNMENTS

QUEEN TEST ALIGNMENT

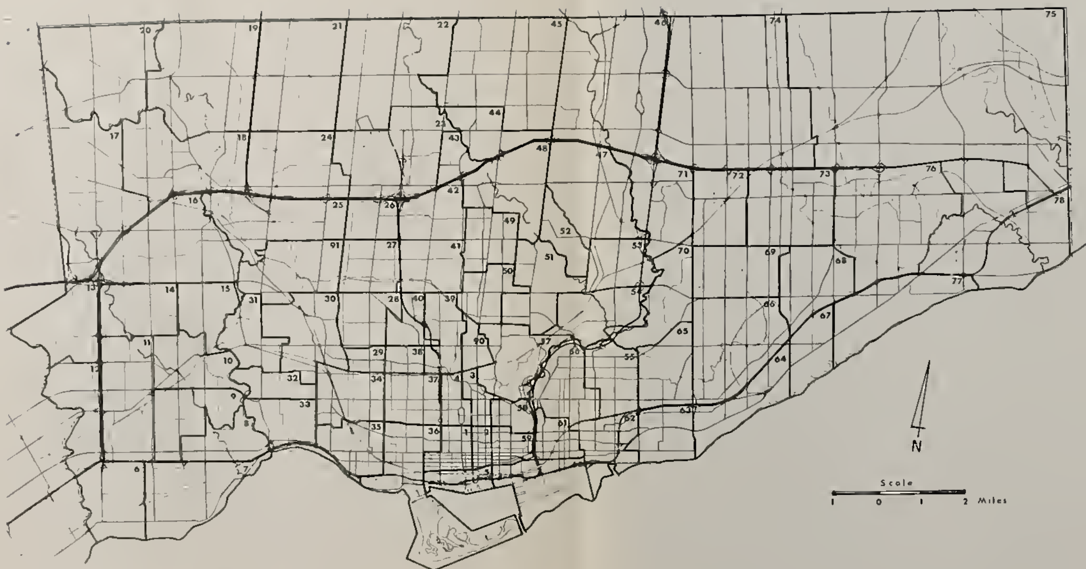
WESTON-QUEEN TEST ALIGNMENTS

Fig. 15



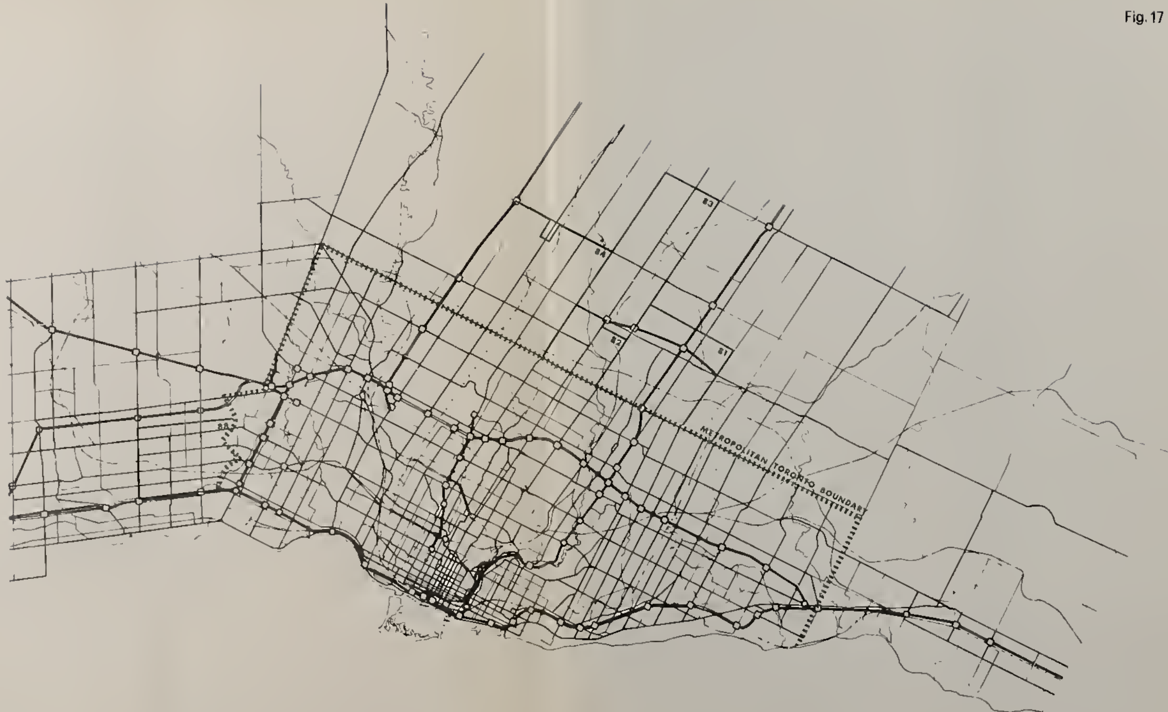
YONGE TEST ALIGNMENT

Fig. 16

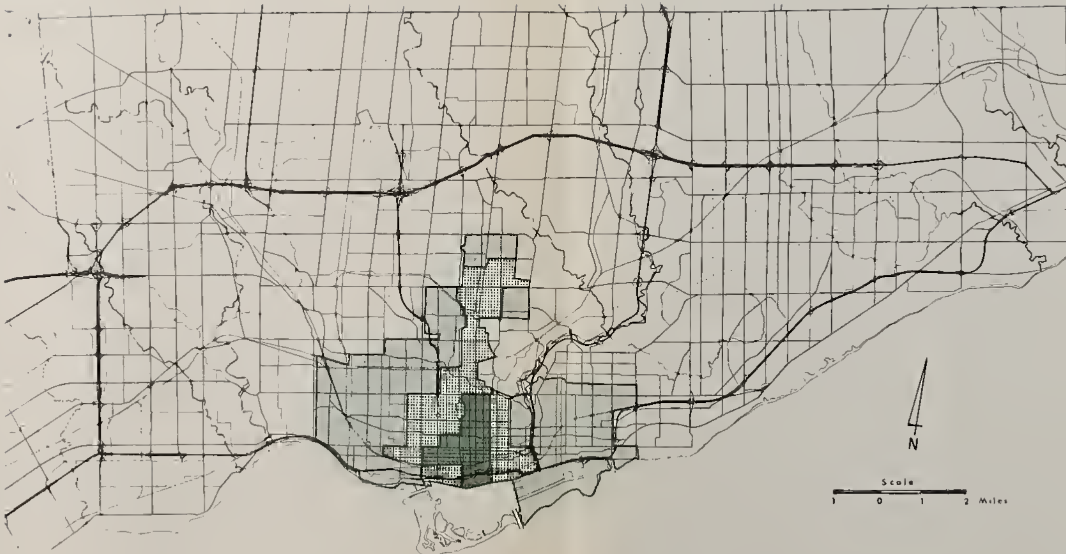


ZONE SYSTEM USED IN METROPOLITAN TORONTO

Fig. 17



ORIGIN ZONES CONSIDERED OUTSIDE METROPOLITAN TORONTO



1980 PARKING CHARGES (IN 1964 DOLLARS)

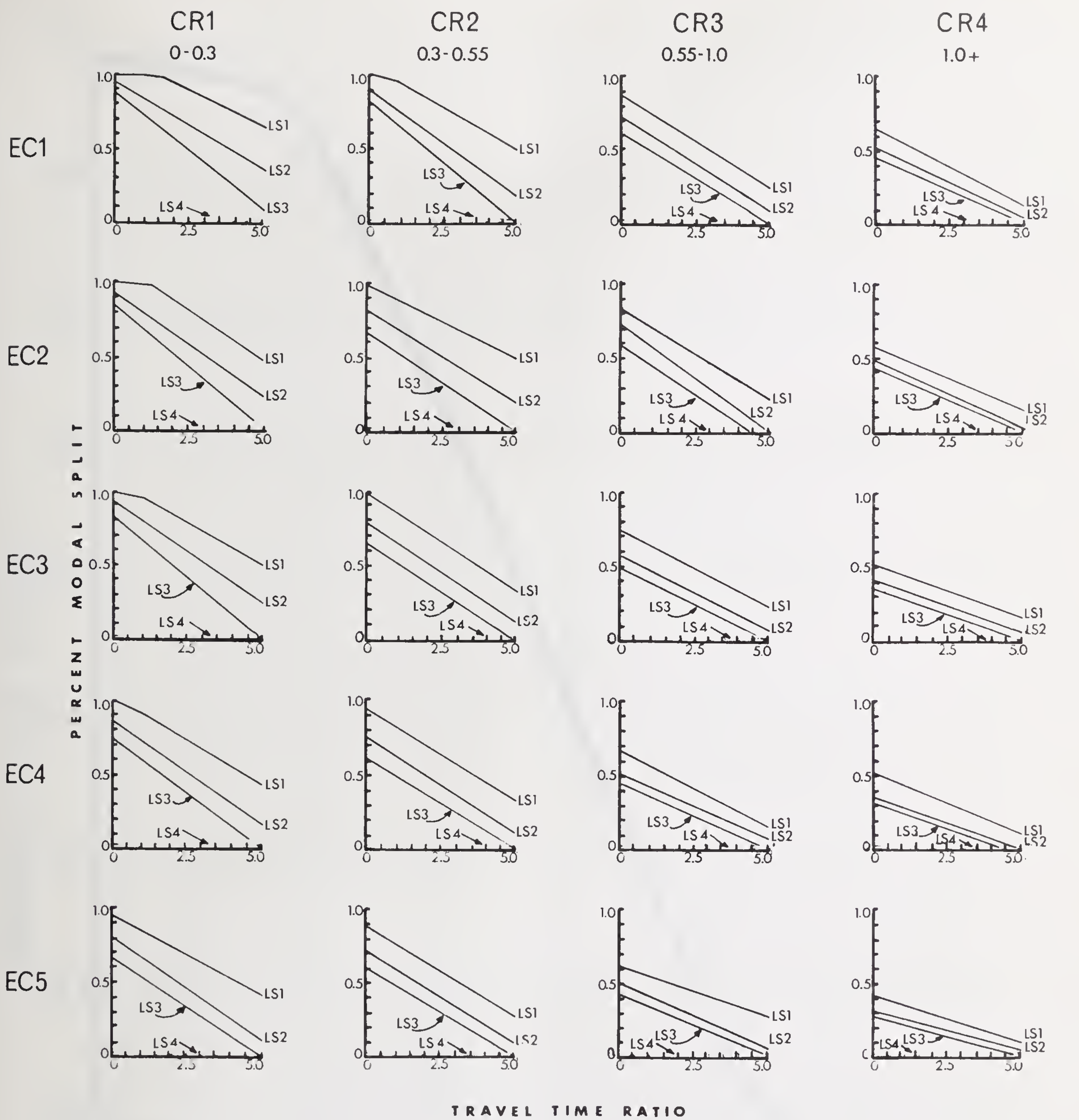
LEGEND

62¢
38¢
19¢

NOTE: Figures Represent 50% of Average Daily Charges by Destination for all Vehicles Arriving

M.T.P.B. MODAL SPLIT RELATIONSHIPS

Fig. 19



Income Groups

EC1	$ 0	-	$3,499
EC2	$3,500	-	$4,749
EC3	$4,750	-	$5,999
EC4	$6,000	-	$7,249
EC5	>		$7,250

Cost Ratio Groups

CR1	0	-	0.30	(0.28)*
CR2	0.30	-	0.55	(0.40)
CR3	0.55	-	1.00	(0.70)
CR4	1.00	+		(2.50)

Level-of-Service Groups

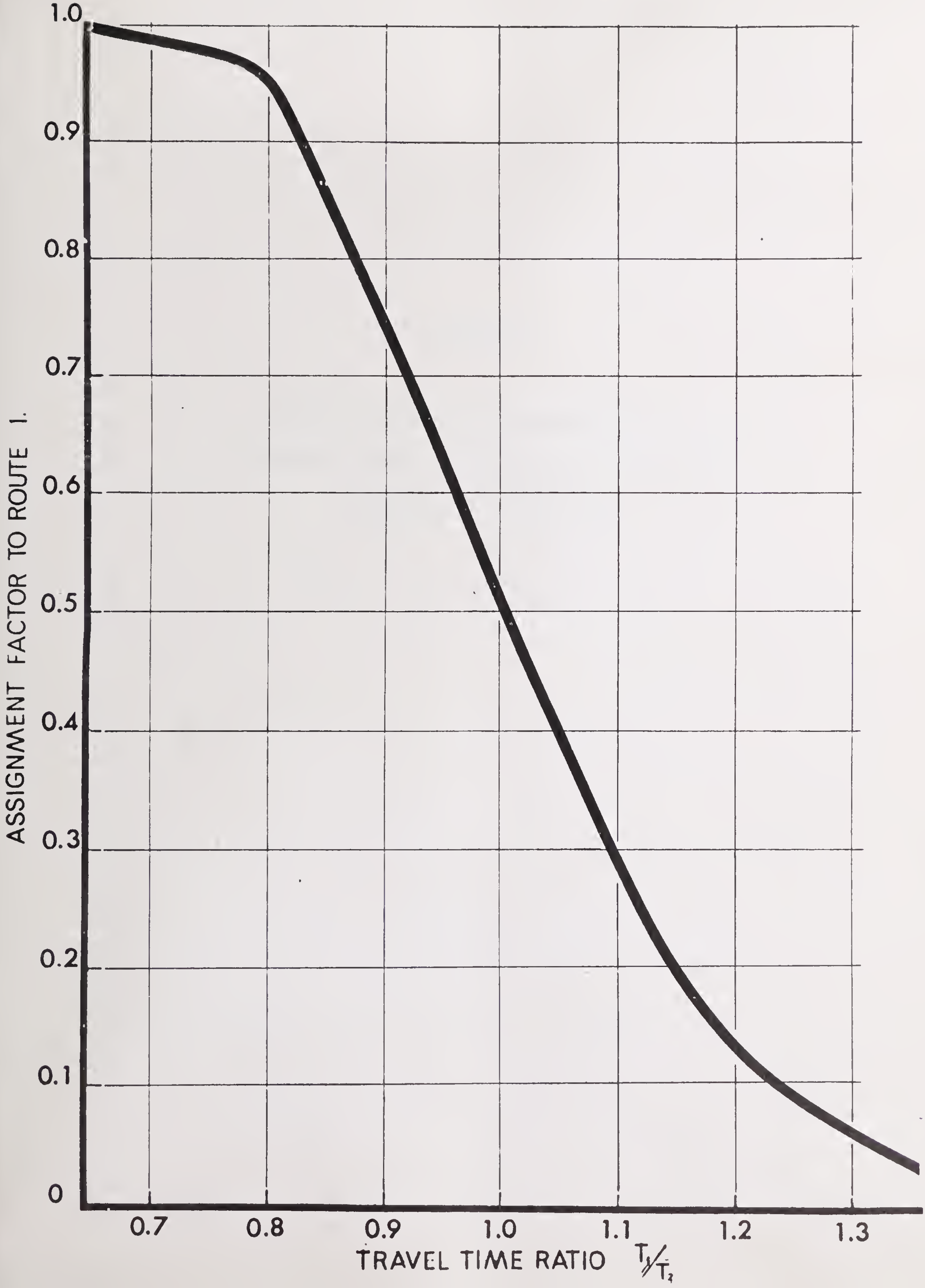
LS1	0-10	min.	(8.8)*
LS2	10-16	min.	(13.1)
LS3	16-50	min.	(18.0)
LS4	50 +	min.	(50.0)

LS4 is the level-of-service at which no transit ridership occurs (0 per cent Modal Split)

* mean of group

Assignment Factor Curve

Fig. 20



APPENDIX

ASSUMED ADDITIONS TO THE STREET AND TRANSIT SYSTEM IN METROPOLITAN TORONTO BETWEEN 1964 AND 1980

ASSUMED ADDITIONS TO THE TRANSIT SYSTEM

IN METROPOLITAN TORONTO BETWEEN 1964 AND 1980

(a) Rapid Transit

(1) Bloor-Danforth Subway: Islington to Warden - 14 miles

(2) Yonge Subway: Eglinton to Sheppard - 3.7 miles

(3) Spadina Rapid Transit: Wilson to St. George - 5.4 miles.

(b) Major TTC Surface Extensions

(1) Albion Rd., Islington to Indian Line
(2) Finch Avenue, Bathurst to 7th Line East.
(3) Steeles Avenue, Yonge Street to Islington Avenue
(4) Sheppard Avenue, Wilson Heights Blvd. to Weston Rd.
(5) Rexdale Blvd., Weston Rd. to Airport Rd.
(6) Highway 27, Dixon Rd. to Albion Rd.
(7) Martin Grove Rd., Bloor St. to Lexington Avenue
(8) Islington Ave., Bloor St. to Lakeshore Blvd.
(9) Royal York Rd., Bloor St. to Dixon Rd.
(10) Jane St., Sheppard Ave. to Steeles Ave.
(11) Keele St., Sheppard Ave. to Steeles Ave. (and to Maple)
(12) Dufferin St., Wilson Ave. to Steeles Ave.
(13) Bathurst St., Patricia Blvd. to Steeles Ave. (and to Richmond Hill)
(14) Avenue Rd. Extension, Wilson Ave. to Sheppard Ave.
(15) Bayview Ave., York Mills Rd. to Steeles Ave.
(16) Leslie St., York Mills Rd. to Steeles Ave.
(17) Don Mills Rd., York Mills Rd. to Steeles Ave.
(18) Steeles Avenue, Yonge St. to Highway 48 (Markham Rd.)
(19) Finch Ave., Leslie St. to Stainer Rd.
(20) Sheppard Ave., Shaughnessy Blvd. to Port Union Station
(21) Ellesmere Rd., Birchmount Rd. to Scarboro College
(22) Lawrence Ave., Orton Park Ave. to Port Union Station
(23) Eglinton Ave., Kinston Rd. to Morningside Ave.
(24) Morningside Ave., Eglinton Ave. to Finch Ave.
(25) Victoria Park Ave., Sheppard Ave. to Steeles Ave.
(26) Warden Ave., Ellesmere Rd. to Steeles Ave.
(27) Kennedy Rd., Finch Ave. to Steeles Ave.
(28) Midland Ave., Kingston Rd. to Finch Ave.
(29) McCowans Rd., Ellesmere Rd. to Steeles Ave.
(30) Markham Rd., Brimorton Dr. to Steeles Ave.

ASSUMED ADDITIONS TO THE STREETS AND HIGHWAYS IN METROPOLITAN TORONTO BETWEEN 1964 AND 1980

(a) Expressways

(1) Spadina Expressway: South of Bloor Street to Dufferin Street and Wilson Heights Blvd. - 6 lanes, 7.8 miles

(2) Highway 400: Highway 401 to Jane Street - 4 lanes, 0.6 miles.

(3) Gardiner Expressway: York Street To Highland Creek - 6 lanes, 16.5 miles.

(4) Don Valley Parkway: Gardiner Expressway to Eastern Avenue - 4 lanes, 0.4 miles; Eastern Avenue to Bloor Street - 6 lanes, 1.2 miles.

(5) Don Valley Parkway: Lawrence Avenue to Steeles Avenue - 6 lanes, 5.2 miles. (Replaces Woodbine Avenue).

(6) Highway 401: Islington Avenue to Highway 48 (Markham Road) - widening from 4 lanes to 12 lanes (6 core, 6 collector - distributor) - 18 miles; Highway 27 to Islington Avenue - widening from 4 lanes to 10 lanes - 2.5 miles.

(7) Highway 27: Queen Elizabeth Way to Highway 401 - widening from 4 lanes to 10 lanes (6 core, 4 collector - distributor) - 4.8 miles.

(8) Queen Elizabeth Way: Evans Avenue to Kipling Avenue - widening from 6 lanes to 8 lanes - 1.6 miles; Kipling Avenue to Royal York Road - addition of collector - distributors - 4 lanes, 1.3 miles.

(b) Arterial Additions

(1) Steeles Avenue: Highway 27 to Islington Avenue - 4 lanes, 2.1 miles.

(2) Finch Avenue: Indian Line to Islington Avenue - 4 lanes, 3.0 miles.

(3) Islington Avenue: Queen Elizabeth Blvd. to Lakeshore Blvd. - 4 lanes, 1.4 miles.

(4) Eglinton Avenue: Jane Street to Scarlett Road - 4 lanes, 0.6 miles.

(5) Sheppard Avenue: Across Downsview Airfield - 4 lanes 0.6 miles.

(6) Avenue Road: Highway 401 to Sheppard Avenue - 4 lanes, 1.2 miles.

(7) Wilson Avenue: Mason Blvd. to Yonge Street - 4 lanes, 0.5 miles.

(8) Lawrence Avenue: Park Lane Circle to Milden Hall Road - 4 lanes, 0.7 miles.

(9) Don Mills Road: Van Horne Avenue to Steeles Avenue - 4 lanes, 1.5 miles.

(10) Ellesmere Road: Scarboro Golf Club Road to Morningside Avenue - 4 lanes, 1.6 miles.

(c) Major Arterial Improvements

		No. of Lanes 1964	1980	Miles
(1)	Rexdale Blvd, Derry Rd. to Bergomot Avenue	2	6	3.2
(2)	Queensway, Cocker Ave. Extn. to Humber River	4	6	4.5
(3)	Finch Avenue, Keele St. to Bathurst Street	2	6	2.5
(4)	Dufferin Street, Wilson Heights to Steeles Avenue	4	6	1.3
(5)	Sheppard Avenue, Leslie Street to Victoria Pk. Ave.	2	6	2.2
	Victoria Pk. Ave. to Highland Creek	4	6	3.4
(6)	Lawrence Avenue, Leslie Street to Kingston Road.	4	6	8.7
(7)	Eglinton Avenue, Leslie Street to Don Valley Parkway	4	6	1.1
(8)	Eglinton Avenue, Eglinton Square to Kingston Road	4	6	4.5

		No. of Lanes 1964	1980	Miles
(9)	Dixon Road, Indian Line to Scarlett Road	2	4	4.5
(10)	Royal York Rd., Dixon Rd. to Lakeshore Blvd.	2	4	6.9
(11)	Jane St., Weston Rd. to Finch Ave.	2	4	4.4
(12)	Sheppard Ave., Weston Rd. to Bathurst St.	2	4	3.3
	Yonge St. to Leslie St.	2	4	2.3
(13)	Finch Ave., Leslie St. to Pickering Town Line	2	4	10.6
(14)	York Mills Rd. Bayview Ave. to Victoria Pk. Ave.	2	4	3.7
(15)	Steeles Ave., Indian Line to Pickering Town Line	2	4	24.3
(16)	Ellesmere Road, Birchmount Rd. to Neilsons Rd.	2	4	3.6
(17)	Victoria Pk. Avenue,			
	Danforth Ave. to Eglinton Ave.	2	4	2.4
	Lawrence Ave. to Sheppard Ave.	4	6	2.3
	Sheppard Ave. to Steeles Ave.	2	4	2.9
(18)	Warden Ave., Kingston Rd. to Steeles Avenue	2	4	9.4
(19)	Leslie St., Eglinton Ave. to Highway 401	2	4	3.5

Form SB-OS-41

1980 RIDERSHIP POTENTIAL ON ALTERNATIVE RAPID TRANSIT FACILITIES IN METRO TORONTO

DEPARTMENT OF HIGHWAYS ONTARIO

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